Contribution ID: **467** Type: **Keynote Presentation**

Laser Cutting of Key Metals in the Construction Industry

Wednesday 8 October 2025 11:50 (20 minutes)

This study examines the laser cutting applications of five key materials in the construction industry: High Strength Steel (HSS), Stainless Steel (StS), Weathering Steel (WS, also known as COR-TEN®), Reclaimed Steel (RS), and Aluminum. The analysis considers each material's unique characteristics, market trends, and the role of laser cutting in increasing sustainability and cost-effectiveness, while addressing both challenges and opportunities.

A combination of literature reviews, technical documents, market reports, and expert interviews was used to assess physical, mechanical, and economic factors, with particular attention to thick sections (10–40 mm) commonly used in construction. Forecasts tracking material use from the 2000s to the 2050s were developed based on the findings.

Results indicate a growing demand for HSS, driven by regulations and structural benefits. The cost-effectiveness of HSS is improved by laser cutting, which achieves tighter tolerances and simplifies welding processes, despite higher base prices of HSS. Stainless Steel is expected to grow in energy and hydrogen infrastructure due to its durability and low maintenance, although achieving high-quality cuts in thicker sections remains a challenge. Weathering Steel provides aesthetic and corrosion resistance benefits, although its protective patina affects laser-material interaction. Reclaimed Steel supports circular economy goals but faces challenges related to regulation, traceability, and surface quality; laser cutting and cleaning may help address these issues. The use of Aluminum is rising in sustainable and solar infrastructure, despite challenges from high reflectivity and thermal conductivity.

Overall, laser cutting enhances efficiency by reducing waste, energy use, and post processing. Material use trends forecast strong growth for HSS and moderate increases for StS, RS, WS, and Aluminum through the 2050s. Further research on optimized cutting parameters, particularly for thick profiles, is recommended to address the growing demand in sustainable construction and the evolving needs of the industry.

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Session Classification: Special Applications & Performance

Track Classification: Steel materials and their application